Space Weather Technical Forecast

Issued on Saturday, 09 September 2023 at 01:14 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-flares (R1-R2 radio blackouts). Slight chance of CME arriving late on Day 1 (09 Sept).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with minor C-class flares, with a peak of C3.7 at 08/1117 UTC, originating from AR3425 in the northeast. There are currently five sunspot regions on the visible disc. The largest and most complex region is AR3423. It consists of two relatively large spots aligned east-west with multiple smaller spots and rudimentary penumbra in-between, and some waxing and waning. AR3421 is becoming less extensive and magnetically simpler, with most spots fading. AR3424 is small and simple, with rudimentary penumbra. AR3425 has shown some consolidation of its leader spot, with its intermediate spots fading and is reducing in its magnetic complexity. AR3417, now approaching the western horizon remains small and simple. A filament eruption was observed near AR3425 in the northeast around 08/1818 UTC, awaiting coronagraph imagery for any potential CME - pending analysis. No Earth-directed CMEs have been observed in coronagraph imagery in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as measured at L1, were indicative of a slow regime. Solar wind speeds were mostly around 340-380km/s. Density was below average throughout. The IMF was weak and below 7nT throughout. The north-south component varied weakly between +/-6nT. The phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2), with an Unsettled interval observed at 08/0000-0300UTC.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux has been at background levels throughout. GOES16 high energy (greater than 2MeV) electron flux was predominantly at background levels but became moderate for a time, peaking at 835 pfu at 08/1645 UTC. The associated 24-hour fluence was below the Active threshold on a declining trend, with 2.43e7 integrated pfu observed at 09/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a chance of M-class flares throughout the period, mostly from AR3423 and AR3425.

Solar Wind / Geomagnetic Activity: The CME that left the Sun on the 05th may arrive at Earth late on Day 1 (09 Sep) or early on Day 2 (10 Sep) with a chance of geomagnetic enhancements. However, it is worth noting that its analysis was contaminated by other CMEs occurring in the background, thus reducing confidence. No other Earth-directed CMEs have been observed in the last 24 hours.

With an absence of significant coronal holes on the western hemisphere, the solar wind is most likely to remain slow-ambient, with no significant or long-lasting enhancement.

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Geomagnetic activity is expected to be mostly Quiet to Unsettled, but with a risk of becoming Active with a slight chance of isolated G1/Minor Storm intervals late on Day 1 into Day 2 (09-10 Sep), under the influence of the CME that left the Sun on the 05th. Mostly Quiet to Unsettled Days 3 and 4 (11-12 Sep).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at background levels, with a very slight chance of an enhancement should any larger flares occur from AR3423 and AR3425, especially later in the period.
High energy (greater than 2 MeV) electron flux carries high uncertainty, however it is thought most likely that fluence will remain below the Active (1e8 integrated pfu) threshold throughout, with just a slight chance of reaching this level mainly later in the period.

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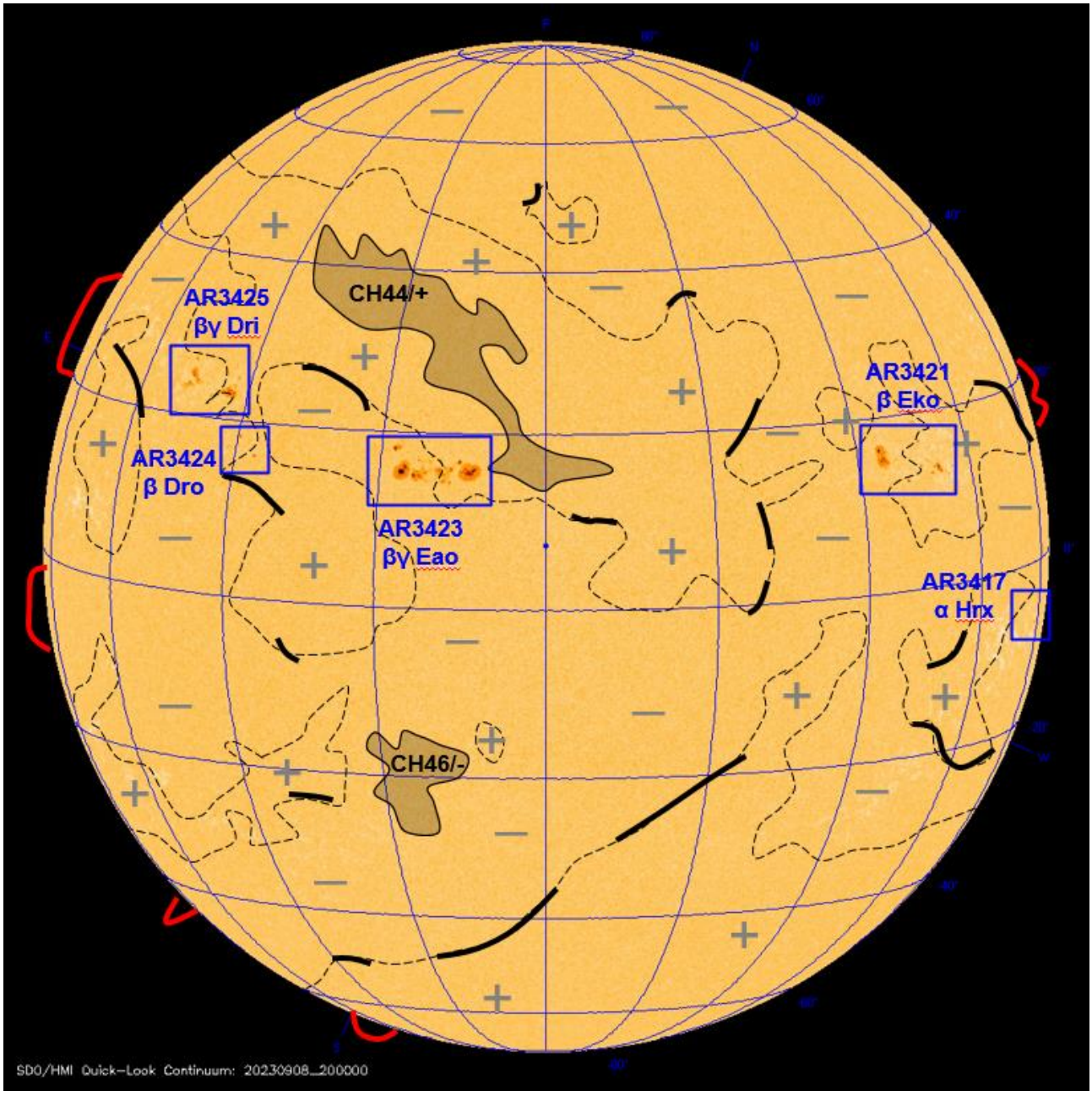
Figure 1. Solar Analysis Valid 08/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME was modelled to have Earth-directed components. This CME, which left the Sun on 05 Sept, has been analysed as fairly slow and should arrive late on Day 1 (09 Sep) or early Day 2 (10 Sep) with a chance for some enhancement of geomagnetic activity. However, it is worth noting that its analysis was contaminated by other CMEs occurring in the background, thus reducing confidence. No other Earth-directed CMEs have been observed in the last 24 hours.
With an absence of significant coronal holes on the western hemisphere, the solar wind is most likely to remain slow-ambient. There may be slight enhancements from CH43/- (no longer visible on SDO imagery) and/or CH/45/- over the next three days but both are small, so much so that corresponding geomagnetic activity is most likely to be muted. The solar wind persistence model (SWPM) is considered to give good guidance in that respect.

In summary, in the absence of any further Earth-directed CMEs, geomagnetic activity is expected to be mostly Quiet to Unsettled, but with a risk of becoming Active with a slight chance of isolated G1/Minor Storm intervals late om Day 1 into Day 2 (09-10 Sep), under the influence of the CME that left the Sun on the 05th. Mostly Quiet to Unsettled Days 3 and 4 (11-12 Sept).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
06/0610	Partial	Plage	S-Centre disc	440km/s	Late 09 Sep	Limited impact expected.

Figure 2: MOSWOC Enlil and ensemble, shows the arrival of a CME at Earth late on 09 Sep.

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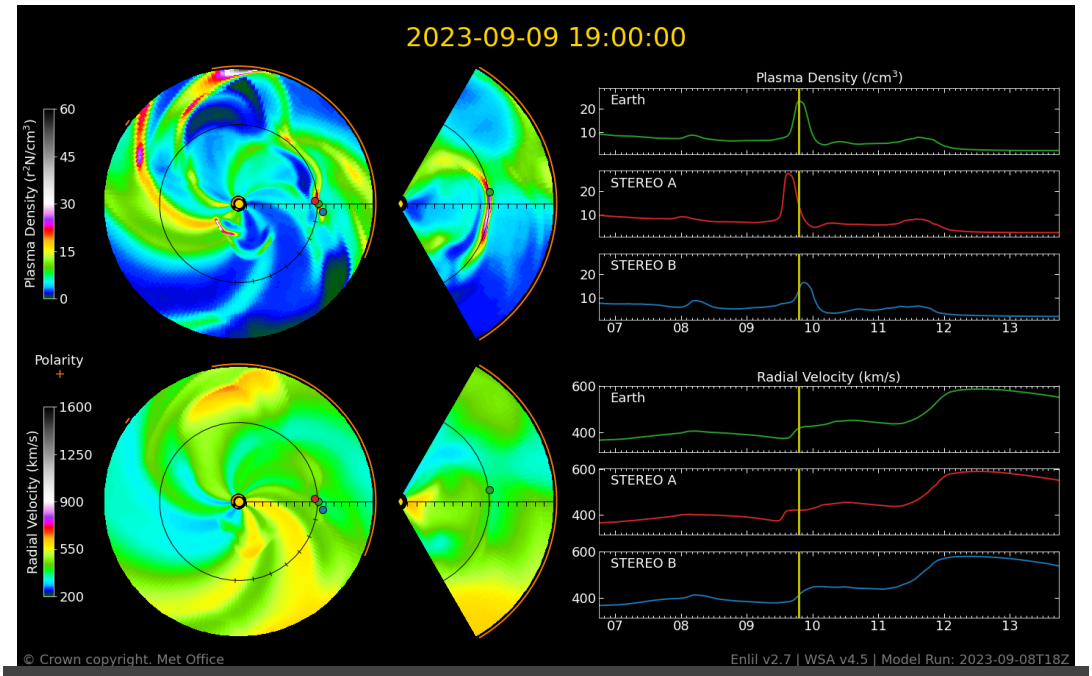

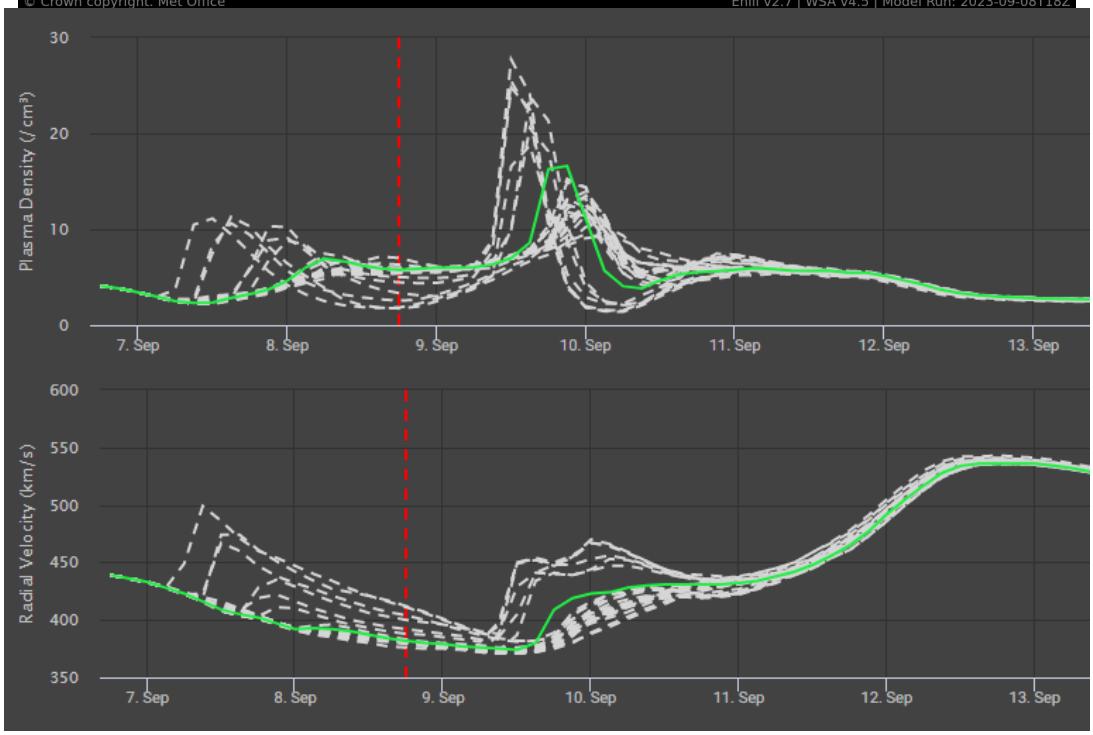

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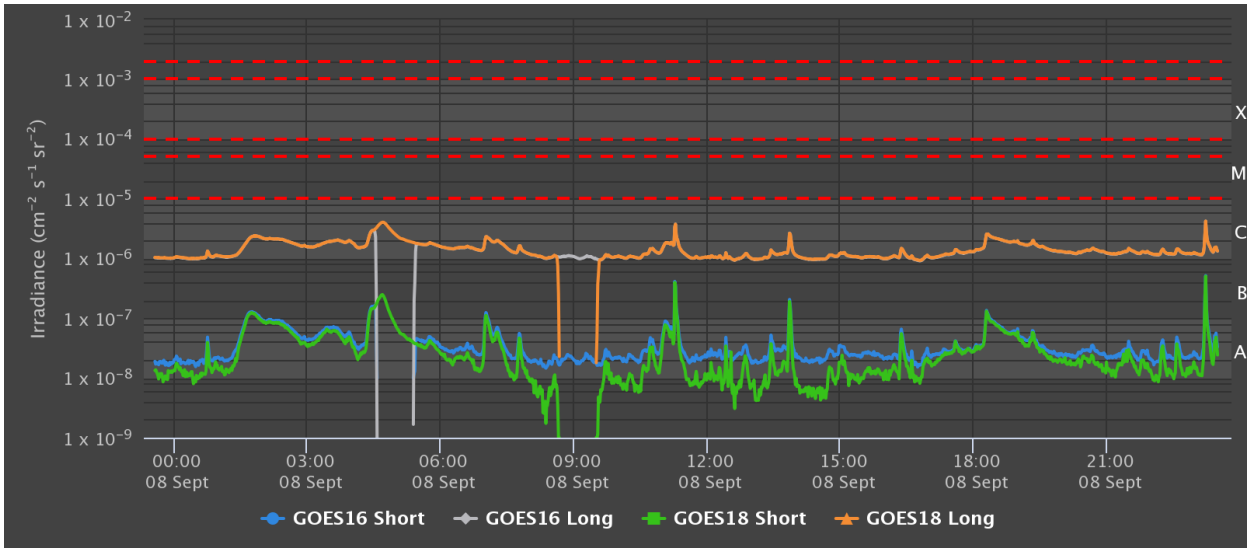
Radio Blackouts - X-Ray Flares:
There are currently five sunspot regions on the visible disc. The largest and most complex region is AR3423. It consists of two relatively large spots aligned east-west with multiple smaller spots and rudimentary penumbra in-between, and some waxing and waning. AR3421 is becoming less extensive and magnetically simpler, with most spots fading. AR3424 is small and simple, with rudimentary penumbra. AR3425 has shown some consolidation in its leader spot, with its intermediate spots fading and overall is reducing in its magnetic complexity. AR3417 is now approaching the western horizon remains small and simple.

There are a significant number of filaments on the visible disc. These will need to be closely monitored for any lift-off. No significant regions are expected to depart the disc in the period. However, there are signs from far-side soundings as well as persistence that one or more new regions may rotate onto the disc in the coming days. The current growing trend from AR3423 and AR3425 means that there is a continuing chance of M-flares throughout the period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES X-Ray Flares



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is now at background levels.

Proton flux is most likely to remain at background levels, although there is a very slight chance of enhancements over the next few days, should any significant flares occur. The most likely contenders are currently AR3423 and AR3425, both in the northeast.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy (greater than 2 MeV) electron flux is likely to remain at background to moderate levels for the start of this period, with further enhancements to the electron belt perhaps occurring through the coming days should fast winds arrive from CH43/- and CH45/-. An increase in flux and fluence levels is therefore possible towards the end of the period. However, there is also the potential for a CME arrival late on Day 1 (09 Sep) into Day 2 (10 Sep) which may suppress electron levels once again.

The associated 24-hour fluence will most likely remain below the Active (1e8 integrated pfu) threshold throughout the period, but with greatly decreasing confidence with time. MOSWOC REFM is considered to be giving good guidance initially, however, confidence falls through the period given the possible arrival of a weak CME.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	20	20	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: REFM electron fluence, observations, forecast and recurrence.

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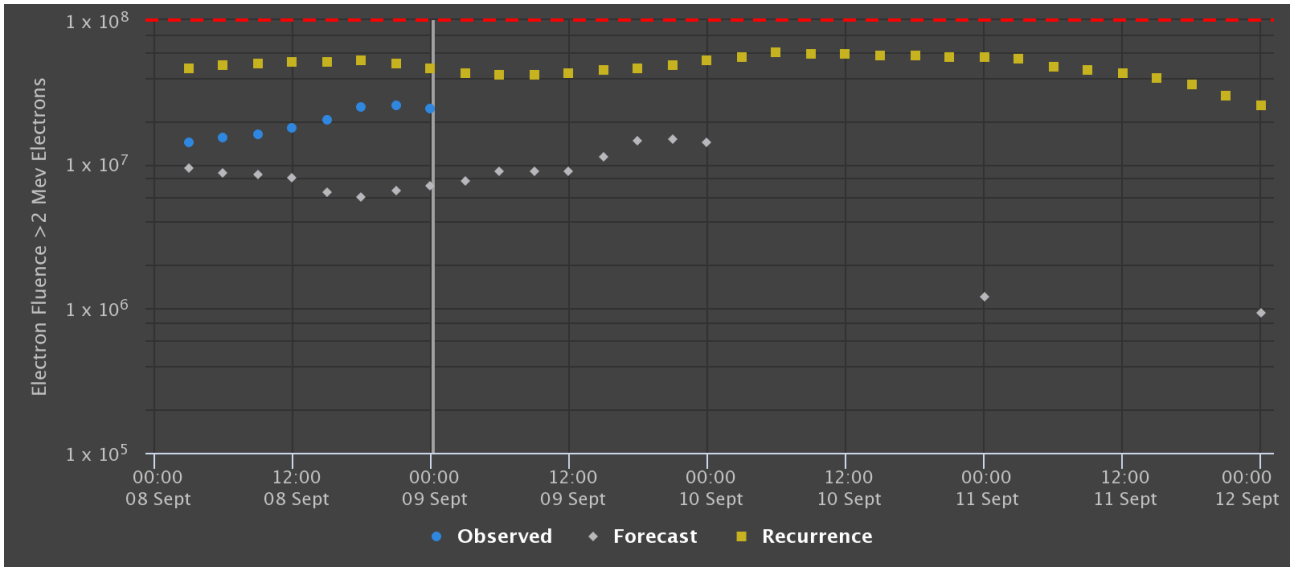

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